Volume 31 March, 1945 *Number 3*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication in the Sugar Industry

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

LUBRICATION OF CANE SUGAR MACHINERY

CANE RAKE

Gears	Texaco Crater
Bearings	Texaco Aleph Oil
Cables	Texaco Crater

CONVEYORS

Chains (Lubrication by Air-Atomized Oil)	Texaco Libra or Nabob Oil
Wheels, Oil Lubricated	Texaco Thuban
Wheels, Grease Lubricated	Texaco Marfak
Gears (Open)	Texaco Crater

CANE KNIVES

Bearings, Oil Lubricated	Texaco Ursa Oil
Bearings, Grease Lubricated	Texaco Starfak Grease

CRUSHER AND MAIN ROLLS

Bearings, Oil Lubricated (According to operating conditions and type of application)	Texaco Cylinder Oils, Thuban or Meropa Lubricant
Bearings, Grease Lubricated	Texaco Marfak
Hydraulic Systems—Oil	Texaco Regal Oil C (R&O) or Texaco Regal Oil E (R&O)
Hydraulic Systems—Water	Texaco Soluble Oil C diluted 20:1 with water
Main Roll Drive Gears (Open)	Texaco Crater
(Enclosed)	Texaco Regal Oil

CRYSTALIZERS AND EVAPORATORS, etc.

Main gears	Texaco Thuban or Meropa Lubricant
Bearings	
Oil Lubricated (According to type)	Texaco Cylinder Oils or Texaco Algol Oil or Algol C
Grease Lubricated	Texaco Starfak Grease

PUMPS

Reciprocating	
Steam End (According to temperature)	Texaco Cylinder Oils
Valve Linkage	Texaco Aleph Oil
Centrifugal	
Governor	Texaco Regal Oil C R&O)
Bearings, Oil Lubricated	Texaco Regal Oil C (R&O)
Bearings, Grease Lubricated	Texaco Starfak Grease
Vacuum Pump	Texaco Algol Oil

CENTRIFUGALS

Anti-Friction Bearing, Oil Lubricated	Texaco Regal Oil C (R&O)
Plain Bearings, Oil Lubricated	Texaco Regal Oil C (R&O) or Texaco Regal Oil E (R&O)
Bearings, Grease Lubricated	Texaco Starfak Grease

STEAM ENGINES

Steam Cylinders (According to temperature)	Texaco Cylinder Oils
Engine Bearings	Texaco Aleph Oil

ELECTRIC MOTORS

Oil Lubricated	Texaco Regal Oil C (R&O)
Grease Lubricated	Texaco Starfak Grease

TURBO-GENERATORS Texaco Regal Oil (R&O)

The above recommendations are general. For specific recommendations for the lubrication of your equipment we suggest you consult a Texaco Lubrication Engineer.

LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

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Lubrication in the Sugar Industry

IN THE pre-industrial era, the refining of sugar was a slow and laborious procedure which consumed much time; it was an uncertain operation under the most favorable conditions. Furthermore, the processes in use were very costly, for approximately two pounds of raw sugar were required to make one pound of refined.

During this period, raw sugar and lime water were heated to effect clarification. On boiling, this solution was repeatedly skimmed off and strained. Ox blood was then usually added as a coagulant. On further boiling, most impurities were brought to the surface. These were skimmed repeatedly until a white scum was obtained. The sugar syrup, after clarification by means of a blanket filter, was transferred to a smaller pan where it was boiled down to give the best results in crystallization. After pouring the "massecuite" into cooling cisterns, the crystals were led into moulds having a hole in the bottom for drainage, where it was allowed to "cure." Some of these cured loaves were remelted to produce "double loaf" sugar; others were covered with moist clay to enable the more complete removal of molasses. Finally the loaves were knocked from the moulds and dried by baking in large kilns; for this reason, refiners were often called "sugar bakers."

SUGAR

SUGAR, as a food-stuff and a source of energy was taken for granted until it became a rationed commodity. Then it developed into a national problem and the cause of many a housewife's headache.

The term sugar is broad; i.e., there are several types of sugar:

Cane or beet sugar	sucrose
Corn or grape sugar	dextrose
Milk sugar	lactose
Malt sugar	maltose
Fruit sugar	xylose
Wood sugar	levulose

Cane sugar and beet sugar are of primary interest: to mankind as one of our principal foods; to the petroleum industry as requiring machinery which must be carefully lubricated.

This matter of lubrication can easily become a problem as the raw materials — sugar cane or beets, are converted almost immediately into juices which must be kept out of contact with the moving parts of the crushing and conveying machinery. Later on in the process of concentration and refining, high speed centrifuges and dryers are employed. Speed and heat also can develop problems of lubrication.

THE MODERN WAY

The industrial revolution brought about remarkable changes in the refining of cane sugar. Through the introduction of steam and steel and by the improvements in methods of clarification and filtration which were introduced, it became possible to handle vast quantities of raw sugar economically. One outstanding development was the invention of the centrifugal machine which reduced the time of curing from two or more weeks to a single day. These and many other inventions brought about a reduction in the price of refined sugar.

Nature allows but a relatively short time for the sugar beet or sugar cane harvest. During this short time, the grinding, crushing, and shredding machinery must operate 24 hours a day until the crop is processed. So the machinery is repaired, reconditioned, and lubricated, to await the first ripe crop from the field.

It is obvious that the failure of any machine part

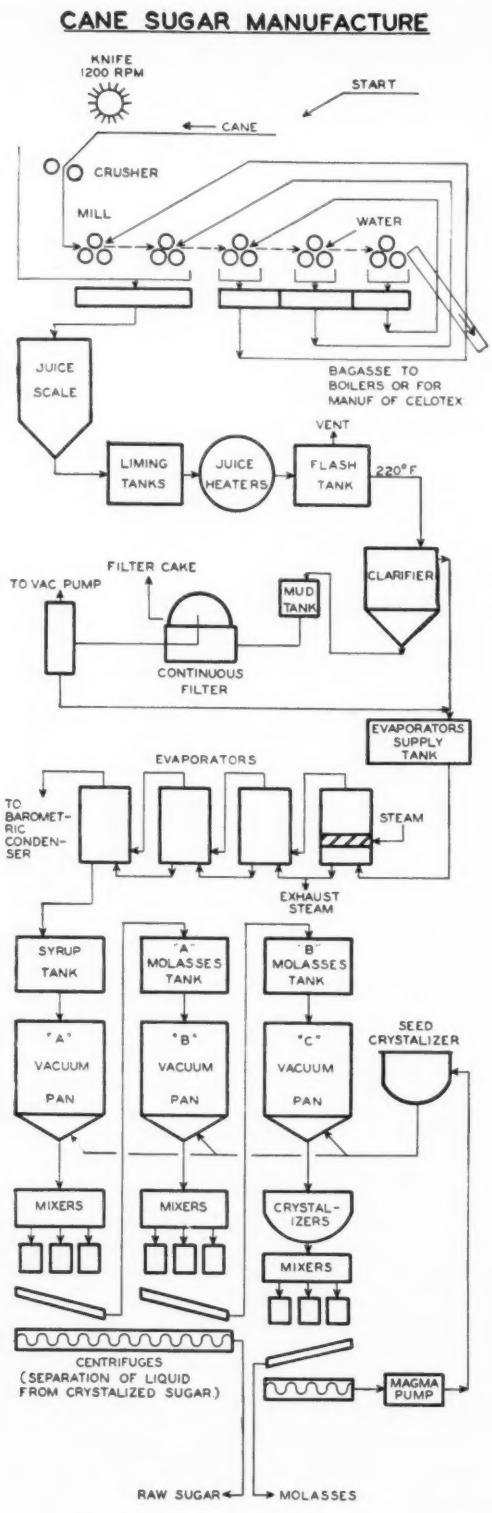


Figure 1.

through faulty lubrication or improper adjustment might cause irreparable losses. In the short space of time available it is mandatory that the mill machinery be able to operate at maximum capacity. Here the selection of effective lubricants plays an important part in the smooth running and efficient operation that is so characteristic of the mills during the grinding season.

Since accurate knowledge of the lubrication of the sugar mill is most essential in this modern, high speed production era, study of mill procedure and lubrication of the most important machinery is advisable to permit greatest operating efficiency.

MAKING CANE SUGAR

As the canes are received at the mill they are loaded onto carriers or conveyors which take them to the crushers and later to the main roll units which are designed to squeeze out practically every drop of juice. The juice extracted by each set of rollers passes through copper strainers, and is conducted through channels and pipes into one large collecting tank. The crushed residue called megass or bagasse goes to the boilers to be used as fuel, or it may be used as wallboard or insulation.

From the collecting tank the juice is pumped into the measuring tank and mixed with a certain quantity of lime for neutralizing the acidity and for clarification purposes, after which it is pumped through steam heated vessels, and raised to the boiling point. Afterwards, it is pumped into other tanks, where it is allowed to settle for a short time so that the impurities will sink to the bottom.

The clear juice is then conducted to a series of evaporators and vacuum pans, there to be concentrated until it attains the consistency of a thick syrup. Concentration is carried out at a low temperaure. The process, known as the "Triple Effect", is carried on in a series of large cells so arranged that the vapors arising from the liquor boiling in the first pan serves to heat and boil the contents of the second pan. The third pan of the series working under a maximum vacuum of 25 to 27 inches in like manner utilizes the vapors from the second pan to heat and evaporate the liquor transferred thereto. The syrup is then ready for crystallization in another set of vacuum pans, crystal formation is carefully noted. The substance at this stage is known as "massecuite"; it consists of crystals mixed up with a syrupy residue called molasses. "Massecuite" is a sticky, dark-colored mass which does not bear the slightest resemblance to golden sugar-crystals, yet in a few seconds, by centrifuging, a transformation takes place.

Importance of the Centrifugal

The centrifugal is probably the key machine in the refinement of both cane and beet sugar. The action of this machine is very much the same as

that of a laundry dryer or extractor. In service, the mixture of syrup plus sugar crystals is pumped into the bowl or revolving element of the centrifugal. Rotation of the bowl at speeds in the neighborhood of 1200 to 2200 revolutions per minute for a sufficient length of time forces the molasses or syrup through the minute holes in the wire gauze liner of the bowl, the sugar crystals being retained.

The crystals are then tumbled out into a conveyor, which takes them up to the storage bins, ready for packing and shipping. The sugar leaves the storage bins via a chute to the ground floor; a weighing machine stands beneath its outlet which can be opened or shut as desired by a slide. Empty bags take their turn on the weighing machine, and as each one is filled to its desired capacity, it is removed and securely fastened for shipment to the refinery.

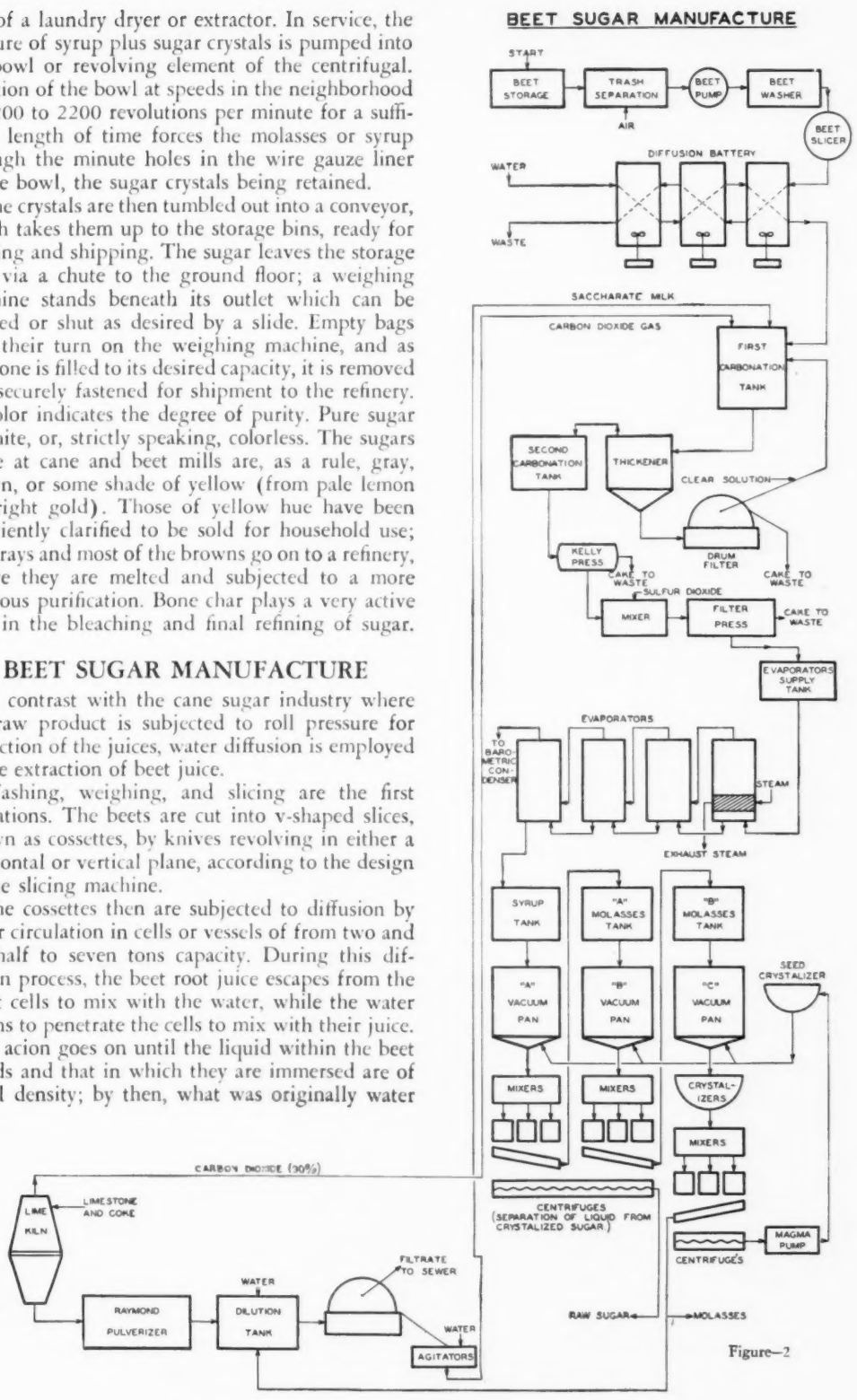
Color indicates the degree of purity. Pure sugar is white, or, strictly speaking, colorless. The sugars made at cane and beet mills are, as a rule, gray, brown, or some shade of yellow (from pale lemon to bright gold). Those of yellow hue have been sufficiently clarified to be sold for household use; the grays and most of the browns go on to a refinery, where they are melted and subjected to a more rigorous purification. Bone char plays a very active part in the bleaching and final refining of sugar.

BEET SUGAR MANUFACTURE

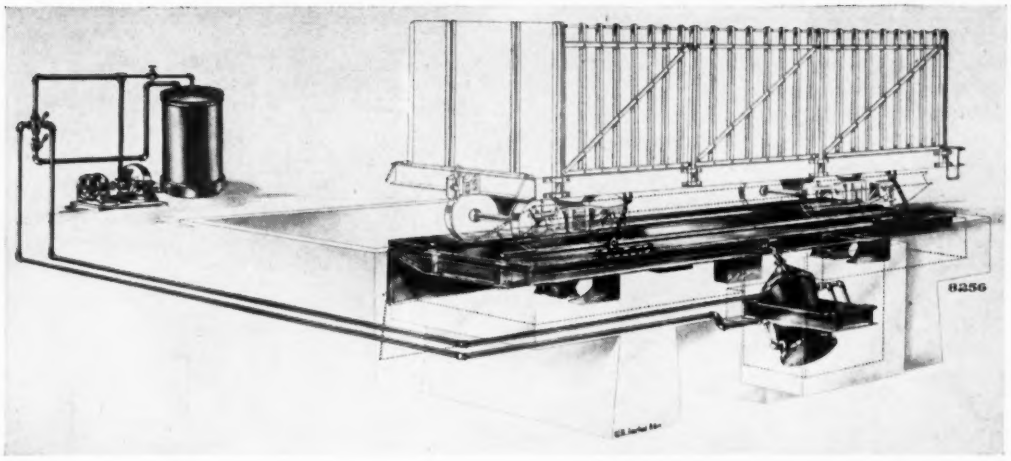
In contrast with the cane sugar industry where the raw product is subjected to roll pressure for extraction of the juices, water diffusion is employed in the extraction of beet juice.

Washing, weighing, and slicing are the first operations. The beets are cut into v-shaped slices, known as cossettes, by knives revolving in either a horizontal or vertical plane, according to the design of the slicing machine.

The cossettes then are subjected to diffusion by water circulation in cells or vessels of from two and one-half to seven tons capacity. During this diffusion process, the beet root juice escapes from the plant cells to mix with the water, while the water begins to penetrate the cells to mix with their juice. This acion goes on until the liquid within the beet shreds and that in which they are immersed are of equal density; by then, what was originally water



Figure—2



Courtesy of Link-Belt Company

Figure 3—Side discharge car dumper with electrically driven pump and hydraulic operating cylinder.

has become syrup. This syrup is conducted to a second vessel containing cossettes, and the same natural mixing again takes place, the original syrup being strengthened with a further supply of sugar juice. This process is repeated until diffusion practically ceases, or until the immersion liquid has become saturated with beet juice. The resultant syrup at this stage corresponds with cane sugar juice after extraction by crushing.

Ten to fourteen diffusion cells constitute a battery, being connected in such a manner that the water passes from one cell to another, beginning at the cell that contains the most nearly exhausted cossettes, being finally drawn off as diffusion or raw juice from the cell in which the new cossettes are added. The exhausted beet pulp, when free from all but a small percentage of sugar, is used as cattle feed.

Clarification

After extraction of the juice by diffusion, it must be subjected to purification. This requires treatment in heaters, and contact with milk of lime. This involves carbonation whereby lime slacked by a dilute sugar solution or saccharate of lime is used, and the mixture is then treated with carbon dioxide gas until most of the lime has been precipitated as calcium carbonate.

After carbonation has been carried out to the desired degree, the mixture is again heated, either

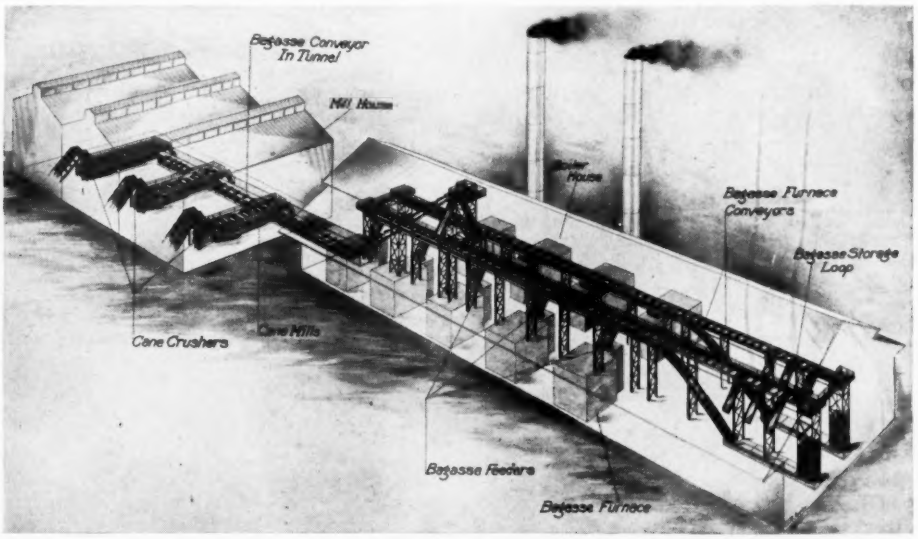
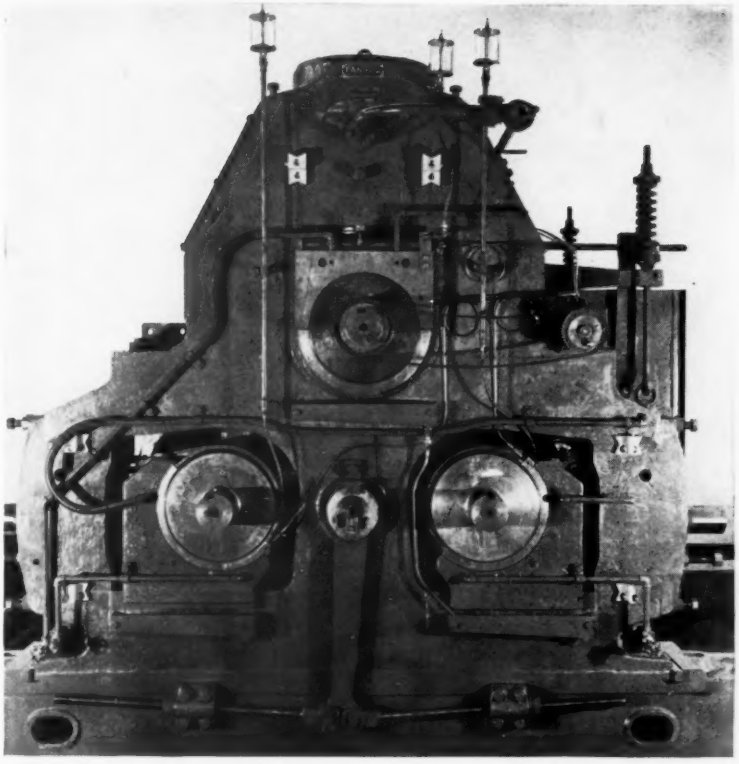


Figure 4—Details of a Link-Belt bagasse carrier showing disposal to boilers.

in the tanks or by being pumped through heaters, following which it is passed to the first filter presses, where the precipitated calcium carbonate and any other impurities contained therein (known as the first lime cake) are removed. The juice from the first filtering process is known as first press juice. A second carbonation treatment follows, whereby most of the remaining lime is precipitated by further contact with carbon dioxide gas.

From the second carbonation, the juice is led to a second series of filter presses, where the precipitated calcium carbonate is removed as second lime cake, the filtrate being known as second press juice. The next process involves a third saturation, therein the juice is treated with sulfur dioxide gas. After this treatment, it is again filtered, this time through what are known as thin juice filters. The resultant filtrate, which is called the third press juice, is then passed to evaporators, where it is concentrated to a syrup containing about fifty per cent sugar.



Courtesy of Farrel-Birmingham Co., Inc.

Figure 5—A Farrel 36" x 78" Three-Roller Sugar Mill with Scharnberg Boltless Housings—this side view of the housing shows the locking keys securing top and side caps. An oil pump driven from the top roll provides automatic lubrication to journals. Drip feed oilers are provided for emergency use.

The juice leaving the evaporators is known as evaporator thick juice. The next step involves what is known as blowing-up, wherein this juice is mixed with melted sugar, and then treated with sulfur dioxide gas. After subsequent filtering through so-called thick juice filters, the resultant syrup is termed blow-up thick juice. Further concentration of this juice is brought about in the white vacuum pan, where it is concentrated to such a point that the sugar content crystallizes out. The whole mass of crystals and liquid surrounding them is called white filmas or white massecuite.

Centrifugal Treatment

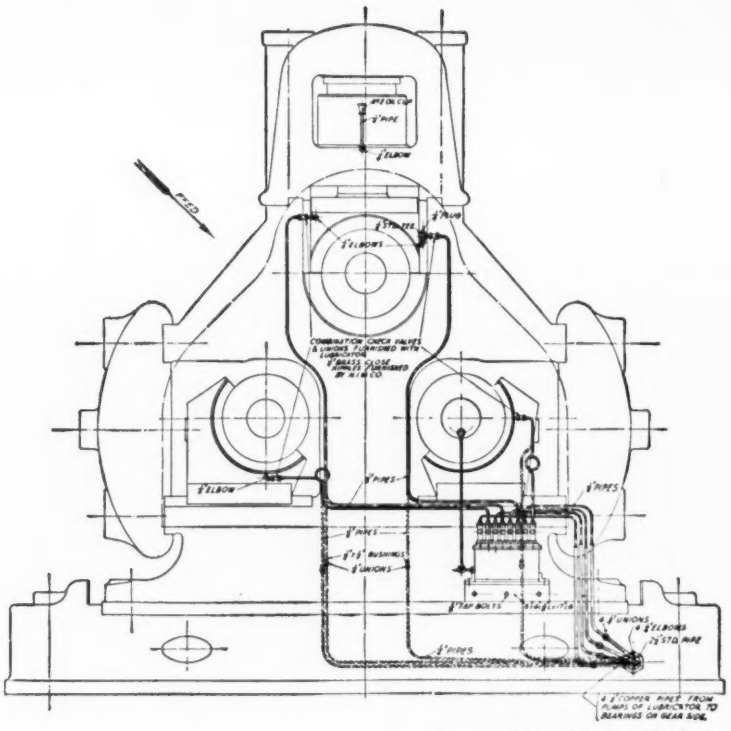
Centrifuging of the white massecuite in making beet sugar is a process of concentration, just as in the cane sugar mill. Since some of the syrup remains on the crystals after centrifuging, it is necessary to wash them with a spray of hot water. The washed crystals are then dried by air in granulators and sacked as granulated sugar. The wash liquor in turn goes into the next white vacuum pan. Further concentration is attained by additional centrifuging.

Drying

The purpose of the dryer is to remove any final traces of moisture which may have remained after the sugar has left the centrifugal and been lightly sprayed with water in order to improve the color.

The dryer involves an inclined cylinder much like a cement kiln, capable of rotation, motion being imparted by gear drives. The weight of the dryer is normally carried on trunnions equipped with suitable rolls. Heat is developed within the dryer by means of steam or hot air. Where steam is used, the air is heated by steam coils located at the lower end of the dryer, or an interior steam cylinder, also capable of rotation, is located along the axis of the dryer cylinder.

Drying is brought about by hot air circulation through the mass of sugar crystals. This is expedited by subjecting these latter to a tumbling action as the sugar passes through the dryer from the high to the low end, lifting shelves being attached lengthwise to the internal wall of the dryer for the purpose of mixing. During this agitation, which occurs once each revolution the currents of air, flowing counter to the flow of sugar, are able to circulate freely throughout the entire mass of the sugar.



Courtesy of Honolulu Iron Works Co.

Figure 6—Elevation of a set of sugar mill bearings equipped for force feed lubrication. Note points of application of oil to the bearings.

LUBRICATION OF CANE SUGAR MACHINERY

Sugar cane must be processed immediately after ripening — it cannot be stored. Mill machinery therefore must be in condition to operate continuously and often under overload during the harvest season, which lasts but a few weeks.

Cane Hoists and Rakes

The first point at which lubrication requires attention is at the unloading platform. Cane may be unloaded by tilting the car on a so-called "basculator," or by means of cranes or cane rakes. A cane rake is operated usually by means of a steam hoisting engine with cables attached to a boom; it rakes the cane onto a conveyor. As these engines are often located at quite a distance from the mill, considerable condensation of steam occurs. This necessitates the use of a specially compounded steam cylinder oil, with good emulsifying properties, to assure of proper lubrication of the steam cylinders, valves, and valve seats.

Open gears and hand-oiled bearings must also be given attention. The gears should be protected by an adhesive lubricant which will remain on the gear teeth and not thin out. This protective film of lubricant must be maintained at all times to prevent wear and excessive clearance between the gear teeth. The bearings, in turn, can be adequately protected by a well refined machine oil of around 300 viscosity (S.S.U. at 100° F.)* applied periodically.

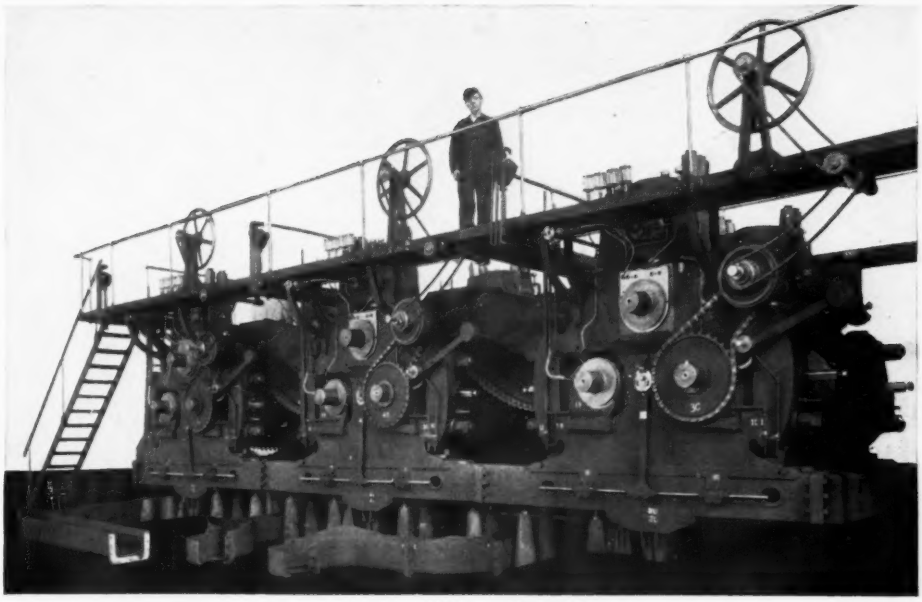
Cables should be kept well lubricated to assure of prolonged service, using a somewhat lighter product, but one of the same nature as is used on the open gears. Renewal of wire rope or cable lubrication can best be accomplished by building a small trough in which the lubricant is placed and through which the cables can be drawn; in this way penetration will be assured so that the cores are completely saturated. If sufficient time is spent in performing this operation before grinding starts, the life of the cables will be prolonged considerably.

Where the cane is unloaded from large railroad cars, a hoisting engine lifts the cane upward and over to the conveyor by means of cables connected to a fork-shaped bucket. Lubrication of these cables is similar to that described above.

*S.S.U. indicates seconds Saybolt Universal Viscosity at the specified temperature.

Courtesy of Farrel-Birmingham Co., Inc.

Figure 7—A side roll box for a Farrel sugar mill.



Courtesy of Farrel-Birmingham Co., Inc.

Figure 8—A Farrel 32" x 66" nine-roller sugar mill. Note the sight feed oilers and other oil piping and fittings near the operators platform.

Conveyors

A conveyor moves the cane from the unloading rack into the mill. This conveyor consists of two endless chains over which metal strips are crossed to form the carrying bed. The chains are equipped with a roller in each link; this roller comes in contact with the guides, carrying the chain links with it, and preventing any sliding or scraping motion. Lubrication is necessary only where the chain comes in contact with the sprockets on each end, and on the rollers between each link.

As it is very essential to keep all cane cuttings away from the underside of the conveyor, a small air line is connected to blow away any accumulations which would cause the chains to ride off the sprockets. These lines are placed at a point where the conveyor returns and where there is the least chance for clogging to occur.

Using compressed air to blow away the accumulation of cane, not only affords an excellent method of cleaning the rolls, but also of lubricating them. A syphon placed in the air line to atomize small amounts of oil, will keep the links and rollers well lubricated. As this oil is completely lost after this operation, it is customary to use a medium refined, straight mineral oil of 150 to 200 viscosity (S.S.U. at 100° F.) which will atomize easily and penetrate the roller pins. The conveyor return is supported by wheels on shafts with open waste packed bearings or grease cups. These are slow moving, and require a fairly heavy oil or a medium-bodied grease.

Cane Knives

Along the path of the conveyors are the cane knives. These operate at a considerably higher speed than the conveyor, so they require more attention. The bearings which support the knife shaft may be of the ring oiled sleeve type, or they may be provided with grease-lubricated ball bearings. The former requires an oil that will not foam and one which will stand lengthy service. The speed and load conditions call for a well refined straight mineral oil of around 750 Viscosity (S.S.U. at 100° F.). Grease lubricated ball bearing units require a product that will not channel, cake or run at high temperatures; one that will resist oxidation and remain in good condition for the duration of the grinding season.

Cane knives may be operated by steam or electric power. The conveyor, however, is driven from the mill end by means of a train of open reduction gears. As in the case of all open type gears, a heavy-bodied adhesive lubricant is needed; one that will form a lasting protective film; one which will not run or sling off under adverse conditions. These gears also may be steam or electrically driven.

Crushers

The cane now passes to the crushers which consist of two rollers. The crushers break down the cane to make it suitable for passage through the mill rolls. In doing this, tremendous pressures are exerted upon the crusher bearings. These pressures

are constant, due to the hydraulic system which controls the top crusher roll. In order for the journal bearings to withstand such pressures, a heavy bodied fluid lubricant is recommended.

Choice of a lubricant for crusher roller bearings depends on local conditions, bearing design, types of grooving, prevailing operating temperatures, methods of application and personal preference of the operator.

These can be met by an oil or grease.

Oil application for crusher bearings may be developed by mechanical forced feed or drop feed lubricators. Grease may be applied by compression cups or by automatic pressure systems.

Frequently, the same lubricant is used here as on the main roll bearings.

A great deal depends upon the application of this lubricant, for much damage can result if it is improperly applied. The direction of rotation of the rollers must be taken into consideration when cutting the grooves of the journal bearings, and the lubricant must be fed in at a point from which it will be carried through the entire clearance space by the rotation of the shaft to completely lubricate the high pressure zone of the bearings.

The Power Unit

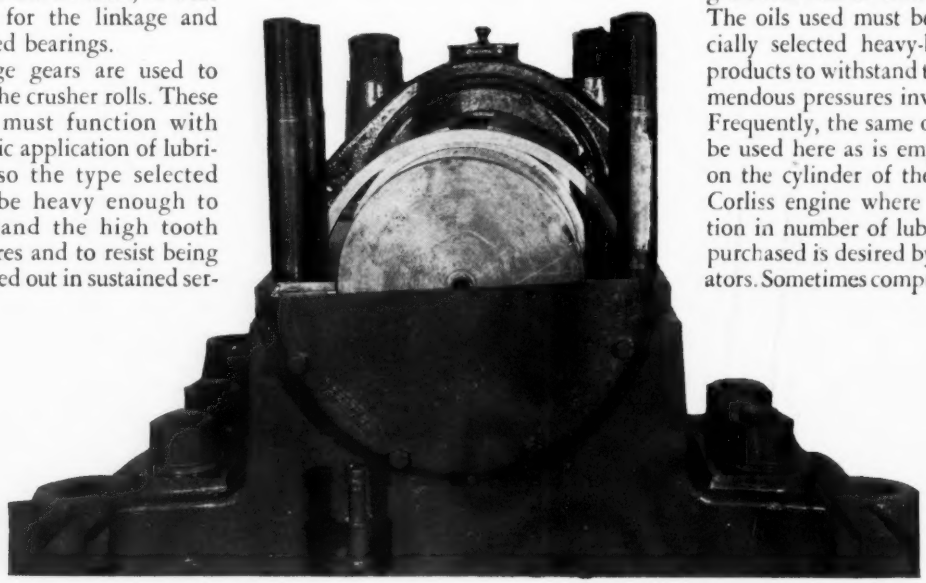
A medium sized steam engine is generally used to supply power to the crusher rolls. This engine is slow moving and condensation of steam occurs during the cycle. A properly compounded cylinder oil therefore is necessary, one which will be able to withstand the washing action of steam condensate. A 300 viscosity (S.S.U. at 100° F.) straight mineral engine oil in turn, is best suited for the linkage and drip fed bearings.

Large gears are used to drive the crusher rolls. These gears must function with periodic application of lubricant, so the type selected must be heavy enough to withstand the high tooth pressures and to resist being squeezed out in sustained service. This lubricant must be of a heavy viscous nature, to prevent exposure of the gear teeth during usage. Some gears may be arranged so that the lower gear dips into a pan of lubricant. In this case, a less viscous gear lubricant is used so that it will follow the gears and not channel. Such a lubricant must be heavy enough to remain on the gear teeth throughout the cycle, while a portion of it is delivered to the upper gear. In order to prevent waste of the lubricant, it is often the practice to fill the pans with water, leaving a small amount of lubricant floating on the surface to come in contact with the main gear. The bearings supporting the gear shafts are lubricated in a similar manner to the bearings of the steam engine and require the same type of lubricant.

Main Rolls

After crushing, the cane is passed through the main roll units. These consist of three rolls to each set. The two lower rolls carry the pressure exerted by the top roll. This latter is connected to the hydraulic system and develops the pressure needed to squeeze the juice from the cane. The pressures exerted on the roll journal bearings are similar in intensity to those developed by the crusher rolls, except that the two lower rolls share the pressure exerted by the top roll. Again, a great deal depends upon the method of application of the lubricant to the bearings.

Mechanical force feed lubricators are used with oils in some plants; other operators may prefer the use of sight feed oilers. Where operators prefer grease as a lubricant, various types of pressure grease lubrication can be used. The oils used must be especially selected heavy-bodied products to withstand the tremendous pressures involved. Frequently, the same oil will be used here as is employed on the cylinder of the main Corliss engine where reduction in number of lubricants purchased is desired by operators. Sometimes compression



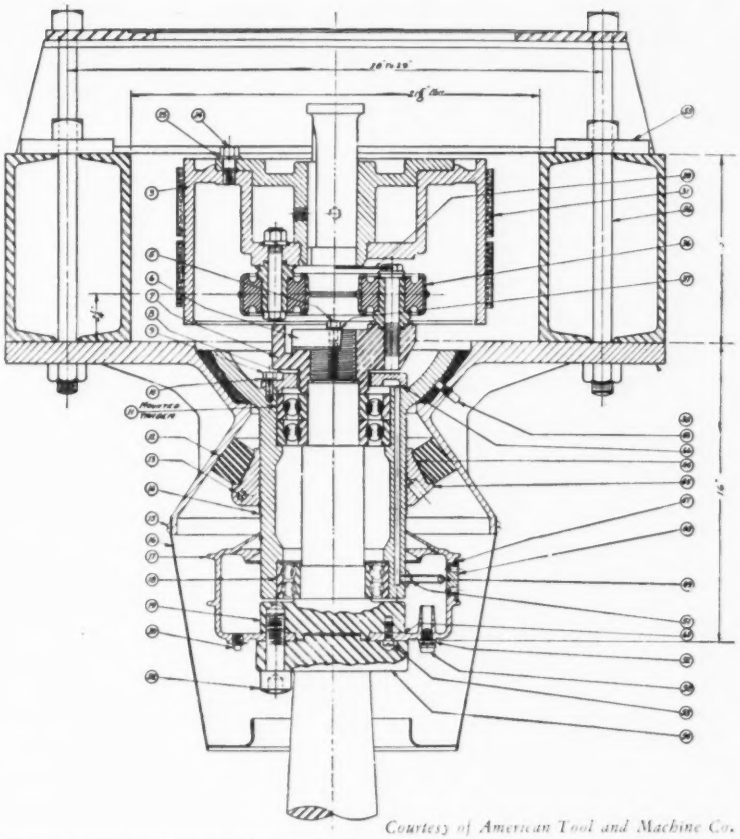
Courtesy of Farrel-Birmingham Co., Inc.

Figure 9—A ring-oiled bearing for the main shaft of a Farrel sugar mill drive.

grease cups are installed for emergency use in case of hot running bearings.

A continuous supply of a heavy bodied oil affords most effective lubrication. However, on some older type mills, hand oiling at regular intervals is still in use. The top roller is lubricated by drip feed, as is also usually the case with the crusher roll.

Care must be taken to see that the bearings are flushed out periodically, otherwise cane juice and other foreign matter which may accumulate in the oil grooves will cause the bearings to overheat. Flushing may be accomplished by installing pipe connections and valves so as to permit steam or hot water to be forced through the oil lines and the grooves in the bearings. This can be done at any time during operation to prevent overheating.



Courtesy of American Tool and Machine Co.

Figure 10—The ball bearing driving head of a direct driven oil lubricated centrifugal. Oil is introduced to oil pot #17. As this pot revolves, centrifugal force causes the oil to wall up against the vertical wall of the pot. The oil is then forced up by rotational inertia through the stationary scoop #49 through the vertical hole in the housing #14; it then returns by gravity to the reservoir or pot.

The Roll Drive

A series of these roll units usually involves from three to five sets. These sets of rolls are normally operated by one or more large Corliss engines driving a train of main roll gears. The main roll drive is the most powerful in the plant, and accounts for most of the power used in the sugar mill. The main driving gears are similar to those driving the crusher rolls, and the lubrication is the same.

These sets of rolls are connected to each other by open gears called crown wheels. All the gears are massive, and require application of a heavy lubricant which will stay on and prevent metal-to-metal contact.

Sometimes pans of lubricant may be placed under the two lower roll gears; they, in turn, will supply ample lubricant to the top roll gear.

Hydraulic Pressure Systems

Inasmuch as the crusher and main rolls are subjected to extremely heavy pressures, it is necessary to have hydraulic pressure regulators. The pressure can be regulated as required usually as indicated by the gauges.

Where oil is used as the hydraulic medium a very highly refined straight mineral oil of 300 to 500 vis. (S.S.U. at 100° F.) should be used in the hydraulic system. It should be so refined as to prevent rust formation; it also should flow readily at low temperatures (if conditions so demand).

Where the hydraulic system calls for water, the use of soluble oil mixed with 10 to 20 parts of water is often desirable to prevent rusting.

Pumps

The cane juice from the rolls is pumped from one treatment to another to concentrate the juice before it is charged to the centrifugals. Both centrifugal and reciprocating pumps are used. In the double acting reciprocating steam pump, lubrication of the steam cylinder is important. Because of the distance the steam has to travel through the plant, it becomes quite wet, requiring a properly compounded cylinder oil for effective lubrication. The valve linkage requires a 300 viscosity engine oil.

Centrifugal pumps may be operated by small steam turbines or by electric motors. The turbines operate at very high speed, and are often equipped with ball bearings. The same oil is used to lubricate

the bearings and control the governor. This oil must be highly refined and must be able to resist oxidation and foaming, because it is constantly being churned and comes in contact with air throughout the system.

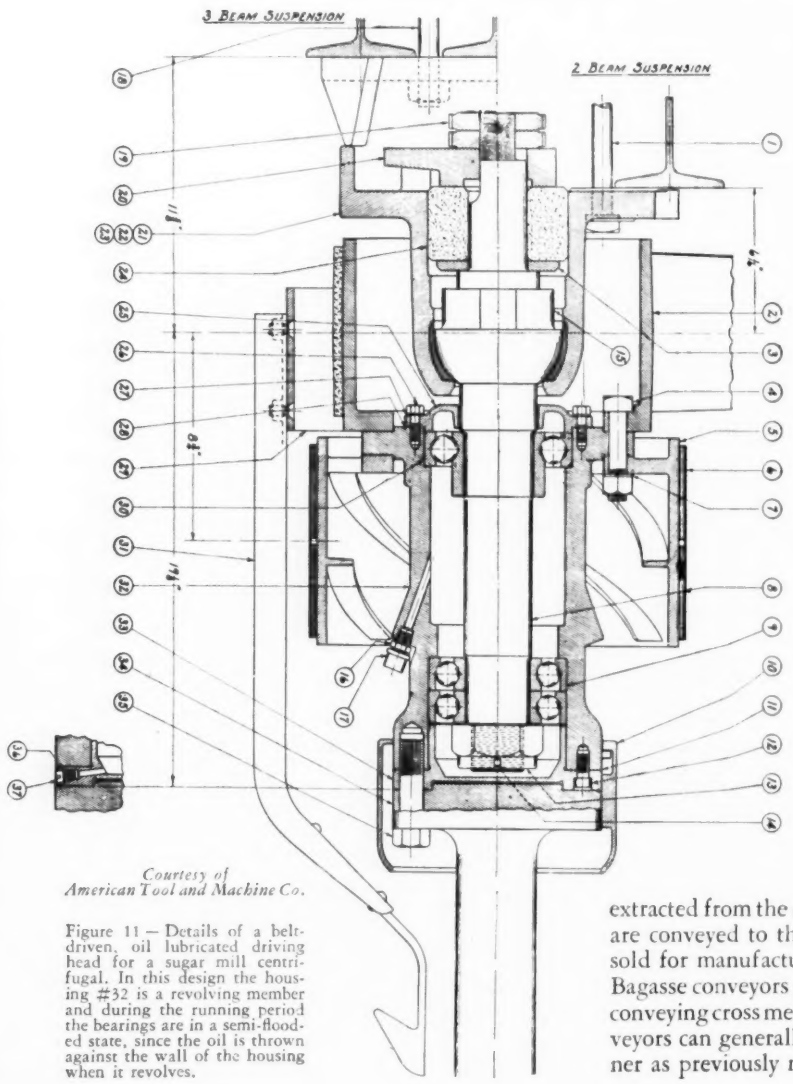
The pump bearings are lubricated by grease or oil, according to design. Oil-lubricated bearings require a well refined straight mineral oil of around 300 viscosity (S.S.U. at 100° F.) as they are lubricated very seldom except for seasonal change. Where grease lubricated bearings may be part of the pump housing the grease acts as a seal as well as a lubricant, to resist the washing action of the sugar juices.

Centrifugals

Centrifugals may be either belt or motor driven. The tendency among some modern designers is to adopt the motor drive; more positive control is available.

By reason of the speeds involved and the necessity for maintenance of even balance of the rotating element, lubrication of the head bearings is of distinct importance. These may be either of the plain sleeve type design, or they may involve anti-friction bearings.

Oil lubrication is customarily provided for, the modern cane sugar centrifugal being equipped with an oil reservoir at the base of the head. Suitable scoops attached to the sleeve carry it up to the top of the head from where it flows to the spindle bearing via piping or a hole drilled in the base casting. After passing through the bearing clearance it is returned to the reservoir for recirculation.



Courtesy of American Tool and Machine Co.

Figure 11 — Details of a belt-driven, oil lubricated driving head for a sugar mill centrifugal. In this design the housing #32 is a revolving member and during the running period the bearings are in a semi-flooded state, since the oil is thrown against the wall of the housing when it revolves.

The grade of oil to be used will depend on the type of bearings installed. Certain types of ball bearing retainers will require a highly refined straight mineral oil of around 300 seconds viscosity. Others will require a lighter viscosity oil. Grease packed bearings require a specially prepared ball bearing grease.

Sleeve-type bearings, in turn, are designed to develop oil pumping action by spiral grooving and centrifugal effect. They also require around a 300 viscosity oil to obtain positive lubrication. Heavier oils up to perhaps 500 seconds viscosity may have to be considered where large units or drop feed oilers are involved.

On the other hand, one must remember that the higher the viscosity, the less fluid will be the oil and consequently the internal friction may be greater. In some installations, this may lead to increased operating temperatures.

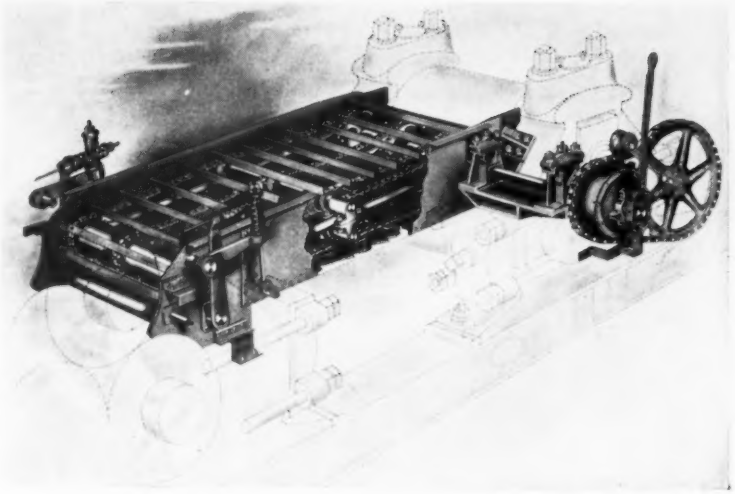
Bagasse Conveyors

After the juice has been extracted from the crushed cane, the remaining stalks are conveyed to the boilers for fuel, or stored and sold for manufacture of insulation and wall board. Bagasse conveyors consist of chains on sprockets and conveying cross members of steel or wood. These conveyors can generally be lubricated in the same manner as previously mentioned under cane conveyors.

The power required to operate the conveyors may be provided by a small steam engine or an electric motor, lubrication of which is similar to other like units in the mill.

Electric Plants

In some sugar mills, turbo generators are replacing reciprocating steam engines as power units. In either type of plant, however, Bagasse is used as fuel for steam generation. In the turbo-generator, lubrication involves bearing protection. The bearing lubricant is also used in the governor mechanism. A highly refined turbine grade oil is required to assure of reliable long time performance, and to reduce maintenance cost to a minimum.



Courtesy of Link-Belt Company

Figure 12—Phantom details of the Ewart intermediate bagasse carrier.

LUBRICATION OF BEET SUGAR MACHINERY

A distinctive problem prevails in the lubrication of beet sugar machinery, by reason of the natural acids which are formed during the process of extraction as well as the various other acids used to expedite this extraction. As a consequence, the bearings, gears, and chains of the machinery involved must be carefully protected by lubrication. Sleeve type, babbitted bearings are extensively used on such machinery as beet slicers, centrifugal pumps, melters, and certain types of centrifugals; use of ball bearings is practicable, however, on the spindles of the latter machines.

Where plain bearings are involved, either grease or oil lubrication is practicable, according to bearing design. Ring oilers, of course, require oil. The use of grease cups is quite prevalent, however, on the step assembly of centrifugals.

Beet Slicers

Beet slicers are quite generally provided with plain babbitted bearings. When fitted with pin-type lubricators, a light bodied grease has proved very satisfactory. The slicing machine is belted to an electric motor, on which a high grade 200 to 300 viscosity, (S.S.U. at 100° F.) straight mineral oil should be used in the ring oiled bearings. This same oil should be used on the ring oiled bearings of electric driven centrifugal pumps.

Pumps and Blowers

The screws of the battery cells in turn can be lubricated with the same grease as used on the slicer bearings. The carbon dioxide pump, which is often of the blower type, is generally direct-connected to a vertical engine. Trunnion bearings of the blower have been very successfully lubricated by a steam cylinder oil of around 130 viscosity (S.S.U. at 210° F.). The driving engine to which the pump is connected requires two types of lubrication, viz.,

(a) crank case, wherein provisions for splash oiling have proved the advisability of using a turbine grade oil which has a high degree of demulsibility and a viscosity of around 150 to 180 (S.S.U. at 100° F.), and,

(b) a compound steam cylinder oil, (as mentioned for trunnion bearings) for steam cylinders.

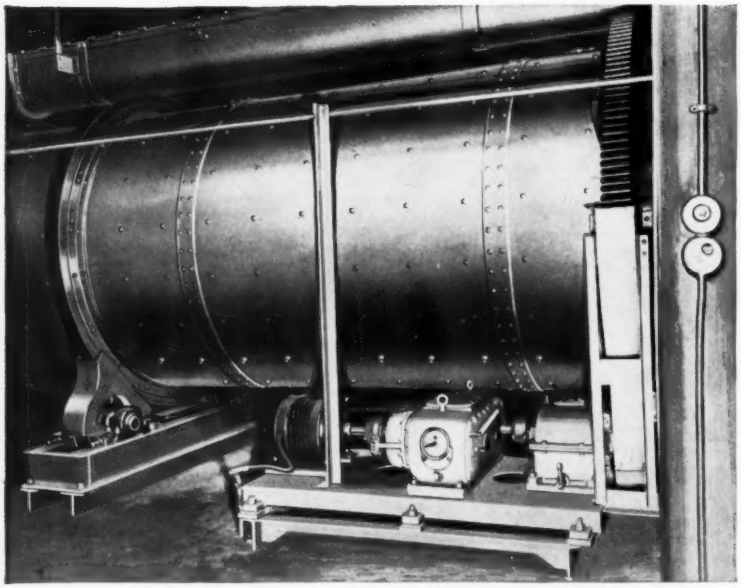
Filter Presses

Filter press screws, incidentally, can be adequately lubricated by this same grade of cylinder oil, compounding being of advantage as an emulsifying agent in the presence of moisture.

Sulfur Stoves

The sulfur stove, as an adjunct in development of sulfur dioxide, is also of interest. Essentially, it is nothing more than a round cylinder. The sulfur is delivered preparatory to ignition by an automatic feeder to the inside of the cylinder. This feeder is motor driven through a speed reducer and a chain drive on the cylinder. A 200 to 300 viscosity (S.S.U. at 100° F.), oil can be used for lubrication of the motor. A heavy bodied specially prepared gear oil is necessary, however, for the speed reducer. This same product can be used for chain lubrication, although certain installations require a somewhat heavier and more adhesive lubricant, in the interest of chain link protection.

A 300 viscosity engine oil is suitable for other



Courtesy of Link-Belt Company

Figure 13—Side view of a Link-Belt Roto-Louvre dryer showing trunnion bearings, girth gear and driving mechanism.

bearings such as those which serve to support the sulfur stove.

Melters

Melters require two types of lubrication, as they involve plain bearings and bevel gears. For the former, a medium consistency grease should be used in compression cups on the drive bearings. The bevel gears, however, require a heavy gear lubricant of approximately 1000 seconds Saybolt viscosity at 210° F., to insure adequate tooth protection under the prevailing operating temperatures.

Centrifugals

These elements are among the most important machines in the beet sugar industry, just as they are in the manufacture of cane sugar. In the beet refinery, their manner of installation requires particular consideration of lubrication. In many plants from 15 to 20 centrifugals are belted to one common line shaft driven by a single electric motor. Ring oiled motor and line shaft bearings require a 150 to 180 viscosity oil as described in connection with the carbon dioxide pump.

Other lubricated elements on the beet sugar centrifugal involve step and spindle bearings. The latter may be of either plain or ball bearing type. Plain bearings are generally designed for oil lubrication, using a 300 viscosity (S.S.U. at 100° F.), straight mineral oil. Ball bearing spindles, however, may require a somewhat heavier lubricant. In view of the operating conditions, it should be a highly refined product, capable of maintaining continued protection and lubrication of the bearing elements without deterioration or gumming.

The step or hub bearings of the average centrifugal carry considerable load. For this reason, they require a heavy, load-resisting grease, capable of withstanding pressure, and able to follow the moving elements without development of undue internal friction. Use of a heavy bodied oil in the manufacture of such a grease will provide these characteristics.

Dryers

As dryers revolve only a few revolutions per minute, speed does not create any unusual lubricating problems. Bearing and gear tooth pressure, however, are comparatively high, for heavy loads must be carried. Furthermore, there is always possibility of difficulty, due to the heat which is radiated from the dryer. The trunnion bearing may frequently run hot. For this reason, a block type high temperature grease is widely preferred.

Where dirt can be kept out of the bearings, it is also practicable to lubricate such parts with heavy oil ranging around 130 viscosity (S.S.U. at 210° F.) dependent upon the means for application.

Regardless of the type of lubricant, however, it is important to remember that whenever they must function under high temperature conditions, lubricants must be selected with due regard for their ability to resist thinning down when subjected to radiated heat.

CONCLUSION

In the foregoing pages we have discussed those conditions of operation which may have a material effect on the performance of lubricants and resulting plant efficiency. It is obvious that both the lubricating engineer and the plant engineer must consider these operating conditions when selecting the most effective and most economical lubricants for the variety of operations discussed. Experience has indicated, beyond question, that effective lubricants which have been properly selected to conform in their characteristics to operating conditions, will function more dependably, prolong the life of sugar mill machinery, and reduce maintenance costs. The expert advice of the lubricating engineer contributes to keeping the overall unit cost per ton of sugar as low as possible.

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LUBRICATION OF BEET SUGAR MACHINERY

BEET SLICERS

Bearings, Grease Lubricated	Texaco Star Grease

PUMPS & BLOWERS

Steam Cylinder	Texaco Pinnacle Cylinder Oil
Crankcase Lubrication	Texaco Regal Oil A (R&O) or Texaco Regal Oil B (R&O)
Trunnion Bearings	Texaco Pinnacle Cylinder Oil

DIFFUSION BATTERY

Agitators, Grease Lubricated	Texaco Star Grease
Agitators, Oil Lubricated	Texaco Alcaid Oil

FILTER PRESSES

Screws	Texaco Pinnacle Cylinder Oil

SULFUR STOVES

Speed Reducer	Texaco Thuban
Other Bearings	Texaco Aleph Oil

MELTERS

Plain Bearings	Texaco Star Grease
Bevel Gears	Texaco Crater

CENTRIFUGALS

Line Shaft, Ring Oiled Bearings,	Texaco Regal Oil A (R&O) or Texaco Regal Oil B (R&O)
Spindle Bearings, Oil Lubricated	Texaco Regal Oil C or E (R&O)
Step Bearings, Grease Lubricated	Texaco Marfak

DRYERS

Trunnion Bearings, Grease Lubricated	Texaco Hytex Grease No. 6
Trunnion Bearings, Oil Lubricated	Texaco Pinnacle Cylinder Oil
Gears	Texaco Crater

STEAM ENGINES

Steam Cylinders	Texaco Pinnacle Cylinder Oil
Engine Bearings	Texaco Aleph Oil

DRIVING GEARS

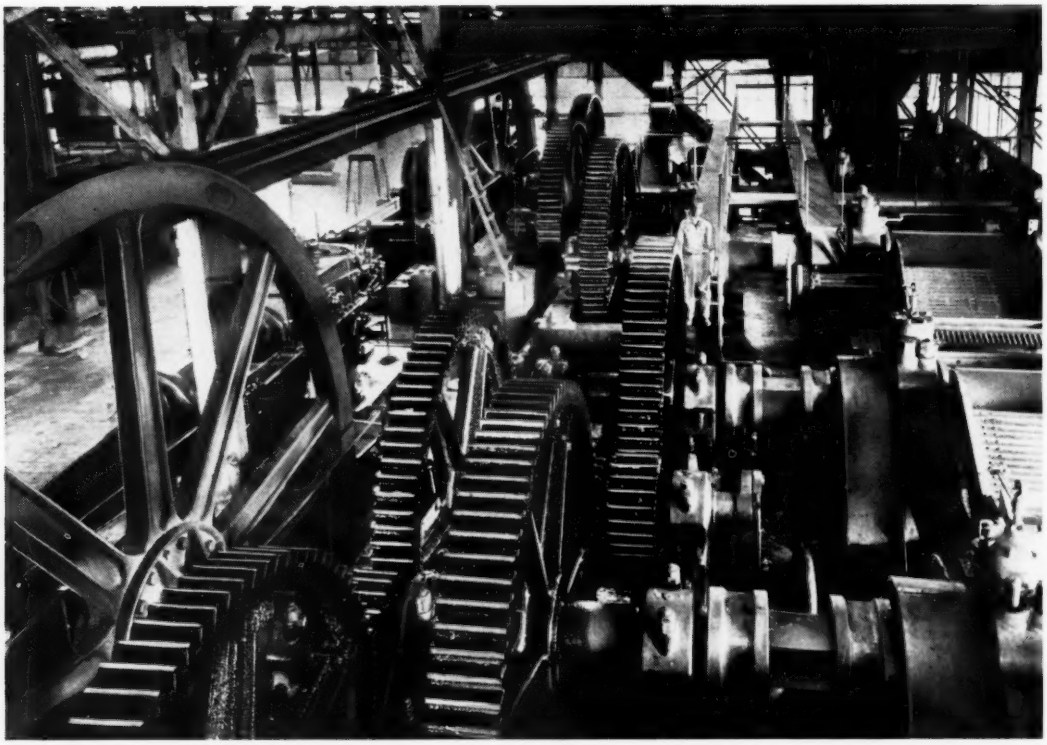
Exposed or Semi-Enclosed	Texaco Crater
Enclosed	Texaco Thuban

ELECTRIC MOTORS

Oil Lubricated	Texaco Alcaid Oil
Grease Lubricated	Texaco Starfak Grease M

TURBO GENERATORS Texaco Regal Oil (R&O)

The above recommendations are general. For specific recommendations for the lubrication of your equipment we suggest you consult a Texaco Lubrication Engineer.



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